

INDOOR AIR QUALITY ASSESSMENT

**Virginia Blanchard Elementary School
65 East Hartford Street
Uxbridge, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of Robert McGuire, Business Manger of Uxbridge Public Schools, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air and environmental concerns at the Virginia Blanchard Elementary School, 65 East Hartford Street, Uxbridge, Massachusetts. Concerns about poor indoor air quality, heat complaints and opportunities for exposure to lead paint prompted this request. On October 26, 2001, a visit was made to this school by Michael Feeney, Chief of Emergency Response/Indoor Air Quality (ER/IAQ), and Paul Halfmann, Lead Paint Inspector Childhood Lead Poisoning Prevention Program (CLPPP) BEHA, to conduct an indoor air quality and lead paint assessment.

The school is a two-story wood clapboard exterior structure. The original school building was constructed in 1870 (see Picture 1). An addition was constructed in 1900 to the rear of the building (see Picture 2). The building has had several renovations to its interior since 1900, with the latest renovation subdividing the school administrative offices with an interior wall. Windows are openable throughout the building. Windows appear to be original wooden sash windows. Classrooms exist in the second, first and basement levels of the building. The front of the building has a finished attic that is currently used for storage. An unfinished attic space exists over the rear of the building and 1900 addition. According to school officials, renovations were done to the rear of the roof within the last 2 years. This project reportedly resulted in rainwater penetrating

into the unfinished attic space, resulting in water damage to ceiling and wall plaster in the second floor restroom (see Picture 3).

During the summer of 2001, CBC Painting of Uxbridge was contracted to prepare and repaint the exterior of the school. During the preparation, the Uxbridge Board of Health received telephone calls concerning the project. They tested paint chips on the ground and found them to contain lead.

In response to public concern, the Uxbridge School Department hired Covino Environmental Consultants, Inc. (Covino), a licensed lead inspection company, to conduct a full lead paint inspection. The inspection was conducted on October 3, 2001 by Darrin Bourret, license # I 3319, and lead levels above MDPH regulatory guidance for residential settings were found on surfaces throughout the interior. In addition, a significant amount of deteriorated lead paint was found on the building's exterior.

The MDPH Regulations 105 CMR 460.000, apply to residential properties built prior to 1978 where a child under the age of six resides. The regulations do not apply to schools. Children spend less time in schools and are generally more closely supervised than when at home. The CLPPP concentrates on children in the home for this reason.

According to available documentation, on February 23, 1994, Covino conducted a lead determination of the Blanchard School's interior areas. A lead determination tests a limited number of surfaces to determine whether lead is present at levels greater than those defined by the MDPH's regulations 105 CMR 460.000. The Covino report was sent to the Uxbridge Public School Department.

The Aulson Company, Inc., a licensed deleading contractor, performed the deleading activities during July/August of 1994. On August 16, 1994, Covino re-

inspected the school and reportedly found all abated surfaces to be in compliance with MDPH regulations.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551. Testing to address lead concerns involved a visual inspection of classrooms and the school exterior and sampling and collection analysis using x-ray fluorescence (XRF) and atomic absorption spectrophotometry (AAS) analytic methods.

Results

The school has a student population of 260 and a staff of approximately 20. Tests were taken during normal operations at the school. Results of air quality tests appear in Tables 1-3. Tables 4 and 5 present results of XRF and AAS analysis for lead content. For purposes of comparison, the results of more recent tests conducted by Covino are also provided in the tables.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were above 800 parts per million of air (ppm) in six out of twelve areas surveyed, indicating a ventilation problem in the building. Please note that rooms with carbon dioxide levels below 800 ppm either had, for the most part, open windows/doors, were unoccupied, or had few occupants.

Carbon dioxide levels in the building would be expected to be higher during winter months, when windows are closed, due to the configuration and condition of the ventilation system.

The building originally possessed a natural/gravity ventilation system, to be used in combination with openable windows. Ventilation is provided by a series of louvered vents. Each classroom has an approximately 3' x 3' grated air vent in the center of an interior wall near the ceiling (see Picture 4), which is connected by airshafts to vaults in the basement. Fresh air movement is provided by the stack effect. The heating elements located in the basement-heating vault warm the air, which then rises up the fresh air ventilation ducts. As the heated air rises, negative pressure is created, which draws outdoor air through windows into the basement-heating vault. This type of system was originally designed to draw air through an openable window system on the exterior wall of the building. This window would be adjusted to increase or decrease fresh air intake. This system appears to have been abandoned. Fresh air intakes are sealed with plywood and were stained to match the interior wooden trim in classrooms.

Exhaust ventilation is drawn from the classroom into a grated hole located at floor level (see Picture 5). No airflow was detected in any of the exhaust vents examined. A flue located inside the duct controls airflow. Above the flue is usually a heating element that creates ventilation in the same method as the fresh air supply system. These louver systems were removed during a previous renovation. The louver system was replaced with a fire damper system. The purpose of fire dampers are to prevent the spread of fire through the ventilation system by closing. Fire dampers are held in place above the duct by a chain equipped with a frangible joint. A frangible joint is made of a material that

melts at a specific temperature. If a fire heats air to a sufficient temperature, the frangible joint melts, releasing the fire damper and sealing the exhaust vent. A fire damper is not designed to control airflow as was the original louver system.

The location of the terminus of the exhaust vent system could not be determined during this assessment. A brick structure on the roof of the building appears to be a typical gravity exhaust vent terminus, however other conditions indicate that the exhaust ventilation system was sealed during a previous renovation. Exhaust vents located in the finished attic appear to be sealed with sheet metal of a different texture than the original ductwork. Other ductwork in the unfinished attic appears to be disconnected and non-operable (see Picture 6). While an exhaust vent terminus exists on the roof of the 1900 addition, the purpose of this vent could not be determined (see Picture 7). A round duct of undetermined purpose was also found open to the attic (see Picture 8). Under these circumstances, it appears that this building does not have a functioning exhaust ventilation system. Without exhaust ventilation, normally occurring environmental pollutants can build up indoors.

During a renovation of the building, unit ventilators (univents) were installed in each existing classroom. Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit (see Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Unfortunately, it appears that each univent, while possessing a fresh air damper, does not have the ability to introduce fresh air into classrooms, since no corresponding fresh air intake vents exist in exterior walls of the building. A careful comparison of the position

of each univent to windows found no fresh air intakes (with the exception of room 001). Therefore, the purpose of each of these univents is to provide heat only. The sole source of fresh air that exists in this building is through open windows.

During summer months, ventilation was originally controlled by the use of openable windows in classrooms. This section was configured in a manner to use cross-ventilation to provide comfort for building occupants. The building is equipped with windows on opposing exterior walls. In addition, the building has hinged windows located above the hallway doors. This hinged window (called a transom) (see Picture 9) enables the classroom occupant to close the hallway door while maintaining a pathway for airflow. This design allows for airflow to enter an open window, pass through a classroom, pass through the open transom, enter the hallway, pass through the opposing open classroom transom, into the opposing classroom and exit the building on the leeward side (opposite the windward side) (see Figure 2). With all windows and transoms open, airflow can be maintained in a building regardless of the direction of the wind. This system fails if the windows or transoms are closed (see Figure 3). Each classroom would have a long pole with a hook that was used to open the hoop latch that locks the transom closed. Most transoms appear to have been permanently sealed during a previous renovation, which can inhibit airflow in the summer if hallway doors are closed. In addition, open windows may also allow for rainwater to penetrate through windows. Pests, such as birds, bats and insects, also have access to the interior if windows are left open overnight.

The cafeteria/classroom has neither fresh air supply nor exhaust ventilation. Further, these rooms do not have an openable window; therefore no air exchange exists in these rooms. Room 001 in the basement also lacks exhaust ventilation.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. The date of the last servicing and balancing was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health

Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

Temperature readings ranged from 69° F to 75° F, which were (with one exception) within the BEHA recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Temperature control is difficult in an old building without a functioning ventilation system.

The relative humidity ranged from 27 to 31 percent, which was below the BEHA recommended comfort range (see Tables). The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. It is important to note however, that relative humidity measured indoors exceeded outdoor measurements (range +6-10 percent). This increase in relative humidity can indicate that the exhaust system alone is not operating sufficiently to remove normal indoor air pollutants (e.g., water vapor from respiration). Moisture removal is important since the sensation of heat increases as

relative humidity increases (the relationship between temperature and relative humidity is called the heat index). As indoor temperatures rise, the addition of more relative humidity will make occupants feel hotter. If moisture is removed, the comfort of the individuals is increased. Removal of moisture from the air, however, can also have some negative effects. Relative humidity in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Water-damaged wall plaster in the second floor rest room and the finished attic indicate that leaks through the roof system had occurred at some time prior to the assessment. Water-damaged wall plaster can, under certain circumstances, provide a medium for mold and mildew growth especially if wetted repeatedly. These materials should be repaired/replaced after a water leak is discovered and repaired.

Concerns were raised about possible water penetration into the basement of the building. Several areas of historical water leaks in storage areas exist in the building, however no sign of active water penetration was noted in the basement, with the exception of some brickwork on the exterior wall of the cafeteria classroom (see Picture 10). A possible pathway exists for water to penetrate through foundation walls from inadequately drained rainwater. In several areas, downspouts from roof gutters empty at the base of the building into dirt or cracks in pavement. The freezing and thawing action of water during winter months can create cracks and fissures in the foundation. Over time, this process can undermine the integrity of the building and provide a means of

water entry into the building through capillary action through foundation concrete and masonry (Lstiburek, J. & Brennan, T; 2001).

A number of areas on the exterior wall appear to have peeling paint and water damaged clapboard. The areas that have the most damaged paint are beneath fire escapes (see Picture 11) or possible leaking downspouts. If rain penetrates through the exterior wall system into the wall cavity, this condition may lead to microbial growth in different building systems.

Lead Concerns

The inspection was limited to the pre-school area, pre-kindergarten area, and the exterior of the building. CLPPP's data on lead screening results indicate children less than four (4) years of age are at the greatest risk. The inspection was therefore limited to the areas used by the youngest children.

Exterior

A visual assessment of the entire exterior revealed a thorough cleaning of all paint chips from the ground had been completed. In addition, temporary fencing has been installed approximately three feet from the building. The building components contain a great deal of loose leaded paint, however, the fencing serves as preventative barrier and will reduce the risk of exposure to paint chips that may fall from the building. The child play area associated with the school is located approximately 50 feet from the building on the other side of a parking area.

Ceilings

The nine ceilings listed on the Covino report as "N/A" and "Loose" were tested using a x-ray fluorescence analyzer. Two ceilings were found to have levels of lead paint

exceeding MDPH regulations for residential properties. These include Room 103, used as a classroom for pre-school children, and Room 204, used a kindergarten classroom. In both rooms the amount of loose paint is limited to an area no greater than two square feet.

Window Sashes

Ten (10) window sashes, from the pre-school/pre-kindergarten areas, were tested with an x-ray fluorescence analyzer. The results supported the findings recorded in the Covino inspection report. A 6-8% solution of sodium sulfide (Na_2S), as allowed by 105 CMR 460.000, was used to determine if the x-ray fluorescence analyzer was reading lead that had leached into the wood, or if a leaded paint film existed. The results were inconclusive.

Paint samples from each of the ten windows were sent to the State Laboratory Institute, Jamaica Plain, for analysis using AAS. The level of lead is measured in percentage by dry weight. A level more than 0.5% by dry weight, as measured by AAS, is considered an elevated level of lead. The laboratory results indicate five of the window sashes tested contain levels of lead that exceed MDPH regulatory limits.

Windows with sills five feet from the floor or below must be deleaded. Windows with sills greater than five feet from the floor, regardless of lead level, need only be intact. The windows in rooms 001 and 002, three of which exceeded 0.5% lead by dry weight, have an intact standard, because the sills are more than five feet from the floor.

Other Concerns

A number of holes were noted in the unfinished roof. While no pests were found inside the attic, these holes can serve as a means of egress for birds, bats, insects and other pests. Each of these holes should be sealed to prevent pest infiltration.

As originally installed, univents were not provided with a means to install filters. A consultant hired to evaluate the indoor air quality in this building retrofitted each univent with a filter system (see Picture 12). Without filters, particles can become aerosolized. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent would be sufficient to reduce airborne particulates (Thornburg, D., 2000; MEHRC, 1997; ASHRAE, 1992). Note that increased filtration can reduce airflow produced by the univent through increased resistance (called pressure drop). Prior to any increase of filtration, univents should be evaluated by a ventilation engineer to ascertain whether they can maintain function with more efficient filters.

Spaces around pipes were noted within all univent cabinet interiors surveyed (see Picture 13). Open pipes and spaces around pipes can serve as pathways for dust, dirt, odors and other pollutants to move from the floor/wall cavities into occupied areas during the operation of univents.

Finally, a photocopier is located in the main office. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). Local exhaust ventilation may be needed in this area to help reduce excess heat and odors.

Conclusions/Recommendations

The renovations conducted in this building essentially removed any means to provide mechanical or natural fresh air supply or exhaust ventilation. The sole source of fresh air in the building is openable windows (with the exception of room 001). This minimization of airflow into the building can result in environmental pollutants concentrating in occupied areas. In addition, the levels of lead detected in some window sashes and ceiling samples warrant further remediation.

In order to address the conditions listed in this assessment, the recommendations made to improve indoor air quality and to address lead concerns in the building are divided into short-term and long-term corrective measures. The short-term recommendations can be implemented as soon as possible. Long-term solution measures are more complex and will require planning and resources to adequately address the overall indoor air quality concerns within this school. To reduce the risk of exposure to lead based paint, the following temporary hazard reduction activities are recommended before full deleading of the Blanchard School is completed.

Short Term Recommendations

Exterior

The perimeter of the building has had paint chips removed and a barrier (temporary fencing) installed. The fencing should remain in place to prevent access to the exterior building components. Any paint chips found during routine visual inspections should be bagged for disposal. The Uxbridge Board of Health and the

Massachusetts Department of Environmental Protection should be consulted for proper disposal.

Interior

Cover loose paint with duct tape or contact paper to prevent further deterioration. Remove any paint chips using a damp paper towel and bag for disposal.

Routine cleaning of horizontal surfaces will reduce the amount of dust. Floors should be damp mopped, not vacuumed. The use of a vacuum cleaner that does not have a HEPA (High Efficiency Particulate Accumulator) filter will result in further dispersal of dust. Standard filters cannot contain small lead particles. Windowsills, tables and desks should be cleaned using a household cleaner and paper towels.

Routinely clean window wells with a household cleaner and paper towels. Opening the top window sash reduces the risk of spreading dust that has settled in the window well area from entering the room.

A letter of Full Deleading Compliance will be issued by a private licensed lead inspector once all work has been completed by individuals authorized by 105 CMR 460.000, re-inspected by the lead inspector and dust sample results are below the current limits established by CLPPP regulations. The amount of lead in dust is measured in micrograms per square foot (ug/ft^2). The permissible amount of lead in dust is dependent on the surface sampled:

Floors	Less than $50 \text{ ug}/\text{ft}^2$
Window Sills	Less than $500 \text{ ug}/\text{ft}^2$
Window Wells	Less than $800 \text{ ug}/\text{ft}^2$

Authorized people are required to conduct deleading activities. The deleading activities are specified in CLPPP's regulations, 105 CMR 460.000. There are three levels of authorization:

Licensed Deleading Contractor

Licensed by the Massachusetts Department of Labor and Workforce Development (DLWD), deleading contractors can perform all deleading activities required to achieve complaints.

Lead-Safe Renovators/Moderate Risk Owners and Agents

These people are trained to conduct moderate risk deleading. Lead-safe renovators are contractors licensed by DLWD. Moderate risk owners/agents are authorized by CLPPP. Moderate risk deleading includes all approved deleading activities except: 1) making large amounts of loose leaded paint intact (more than 2 sq. ft. in any room or 10 sq. ft. on the entire exterior), and 2) removal of components by demolition.

Maintenance personnel employed by the Uxbridge School Department could qualify as moderate risk agents to conduct deleading activities at the Blanchard School and, if utilized, could affect the overall cost of the project.

Low Risk Owner/Agent

Authorized by CLPPP, low risk personnel can perform limited deleading activities, such as covering leaded surfaces, removal of limited types of components and the application of encapsulates. Maintenance personnel employed by the Uxbridge School Department would qualify for low risk deleading activities that could affect the overall cost of the project.

Short-Term Recommendations for Non-Lead Indoor Air Quality Concerns

1. Seal holes in tarmac around the exterior walls and install means to direct rainwater from the base of the building.
2. Seal all holes in the attic to prevent pest infiltration.
3. Remove debris from ducts in the unfinished attic and seal temporarily until the purpose of each duct is identified.
4. Render airtight all holes/seams in univents.
5. Use the sash windows in air mixing rooms to introduce fresh air into the building.
6. Use open windows and hallway doors to enhance airflow during warm weather. Be sure to close windows and doors at the end of the school day. To aid in the draw of fresh outdoor air in warm weather, use portable fans directing air out windows on the leeward side of the building. Fans positioned in this manner will serve to increase the draw of outdoor air across a floor without interfering with the natural, internal airflow pattern of the building. To aid cross ventilation, open hallway doors in areas with inoperable transoms.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate air (HEPA) filter-equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

8. Consider installing local exhaust ventilation in the photocopier area.
9. Repair water damaged plaster in the basement.

Long Term Recommendations

1. Prior to any upgrade to mechanical systems, consideration should be given to upgrading the electrical service and related wiring in the building. Installation of new ventilation equipment may require more electrical power than the current system can provide. Since the original fresh air ventilation system is abandoned, these ducts may be used as “wire conduit” to retrofit the building’s electrical system.
2. Consult a ventilation engineer to determine whether existing univents can be retrofitted with a means to provide fresh air. If not feasible, consideration should be given to replace the existing univent system.
3. Consult a ventilation engineer to determine whether the deactivated ventilation system can be repaired. This work would include restoration of ductwork in the unfinished attic and restoration of louvers in classrooms to control airflow. Consideration should be given to installing an alternative mechanical ventilation system in this section of the school.

References

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105 CMR 460.000.

Figure 1 Unit Ventilator (Univent) Installed in Wall with No fresh Air Supply Vent

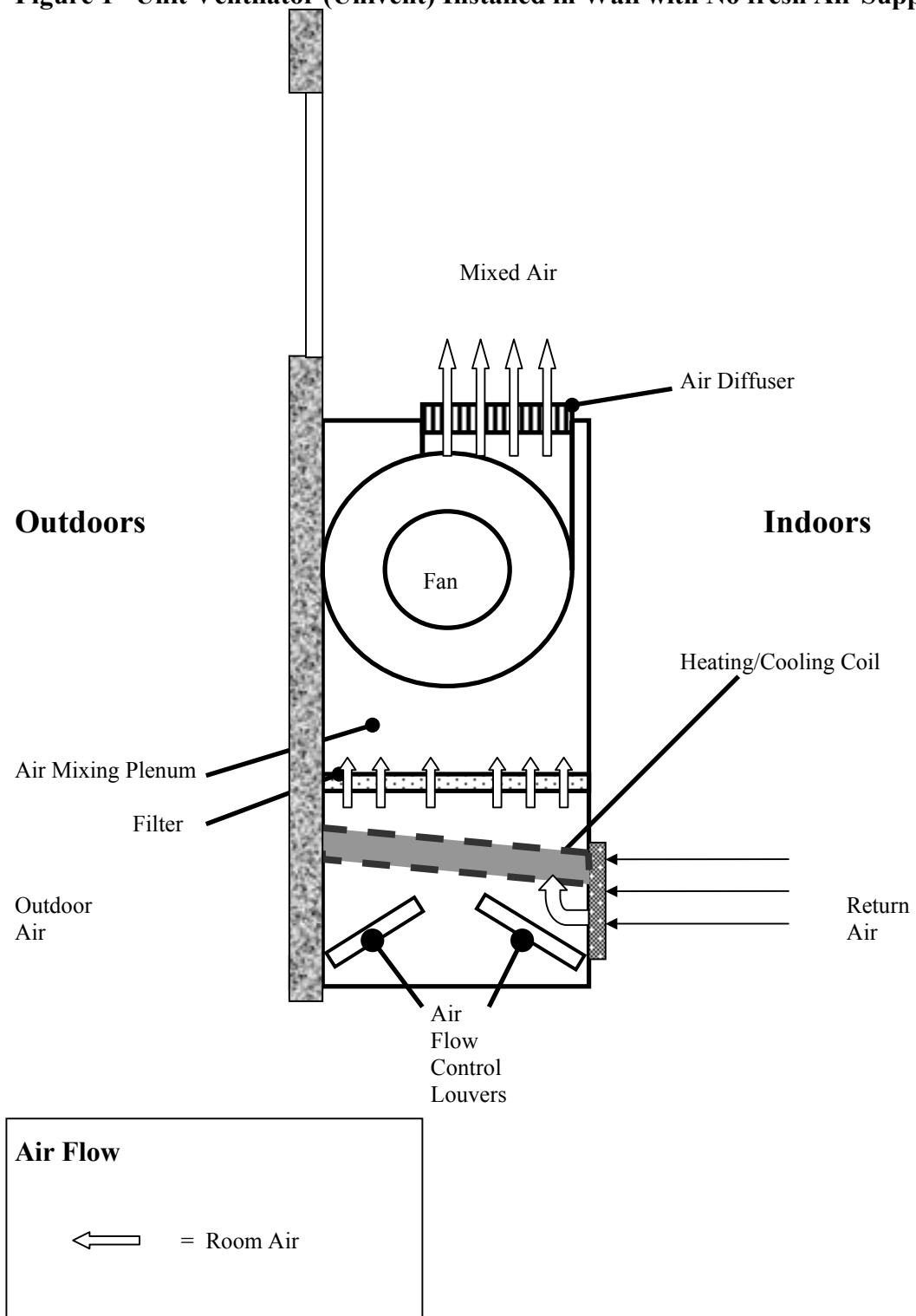


Figure 2

Cross Ventilation in a Building Using Open Windows and Transoms

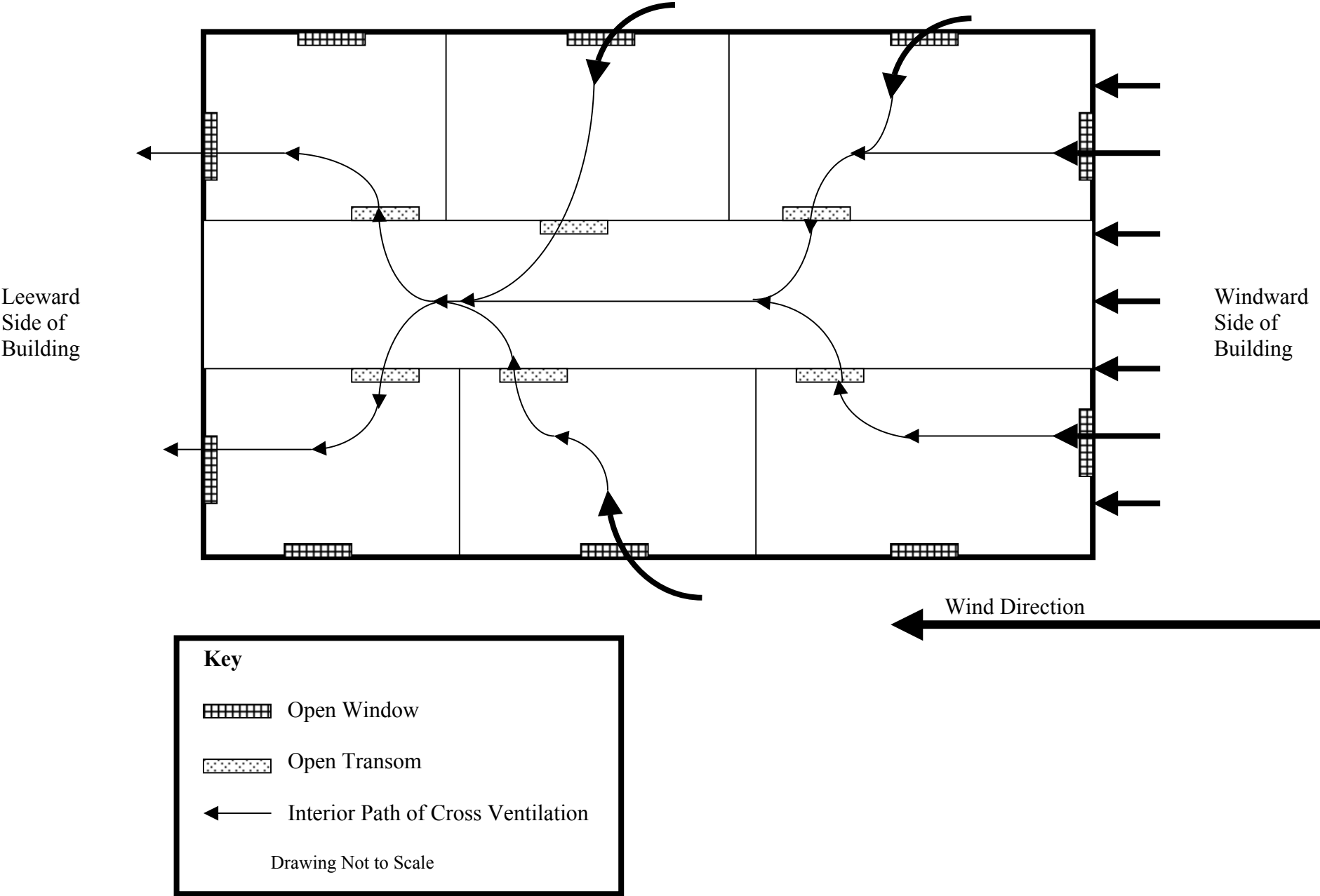
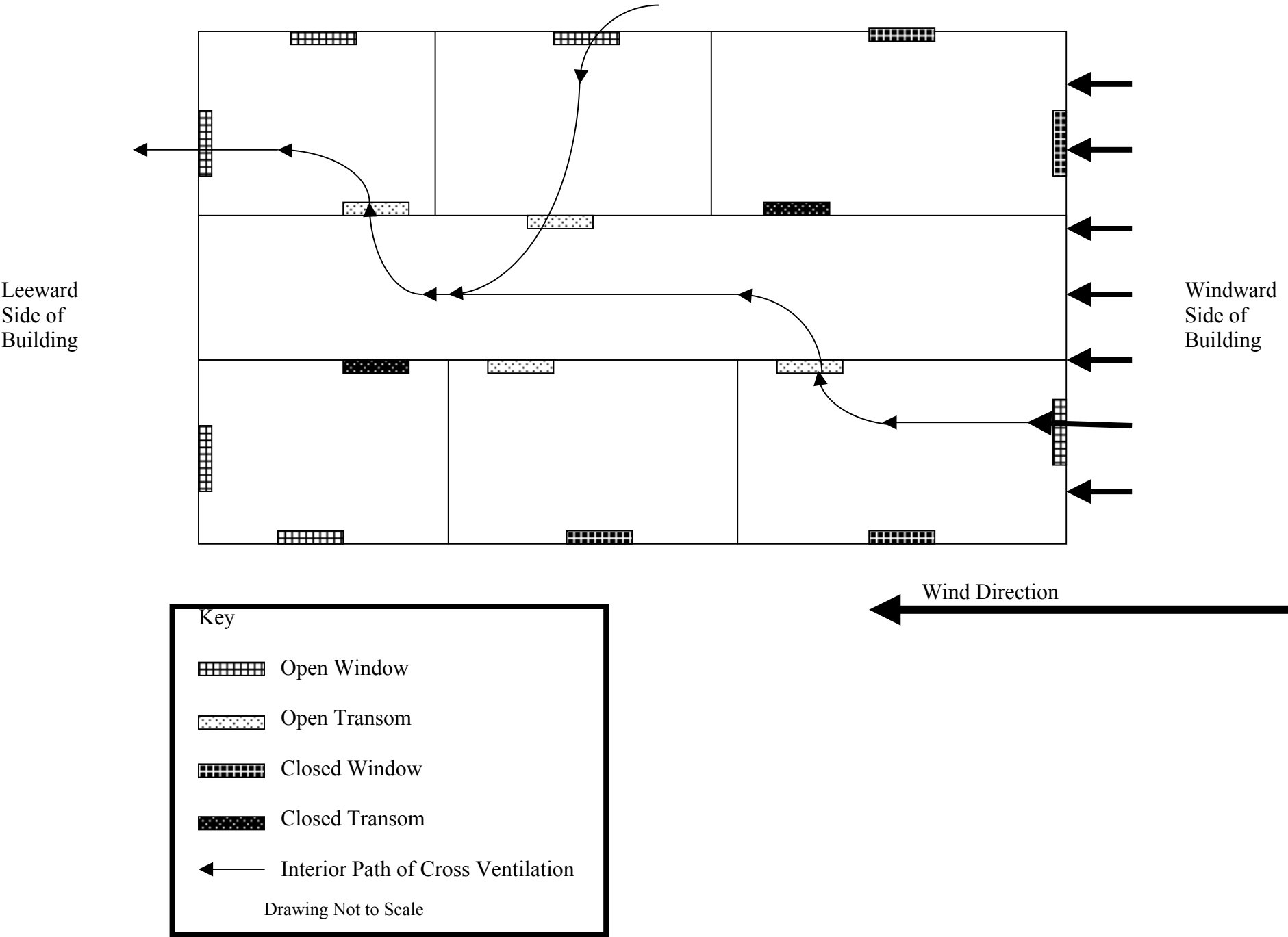


Figure 3

Inhibition of Cross Ventilation in a Building with Several Windows and Transoms Closed



Picture 1



The Original School Building, Constructed In 1870

Picture 2



1900 Addition

Picture 3



Water Damage To Ceiling and Wall Plaster in the Second Floor Restroom

Picture 4



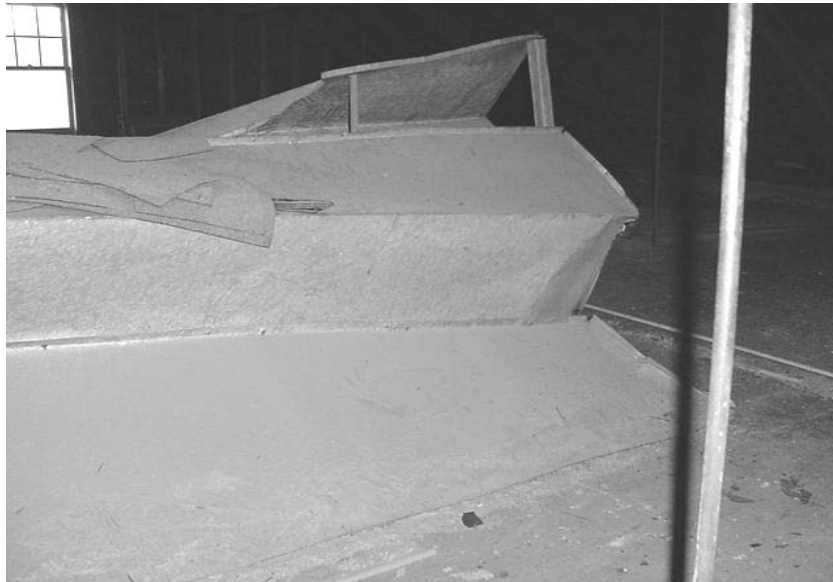
Original Fresh Air Supply - Sealed with Plywood

Picture 5



Exhaust Vent: Note Missing Louver and Chain

Picture 6



Crushed Ductwork in the Unfinished Attic

Picture 7



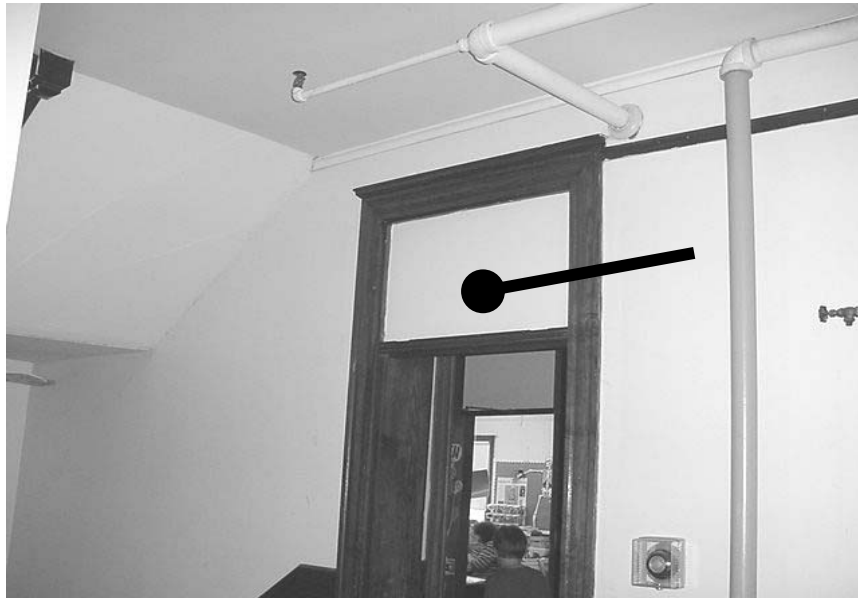
Exhaust Vent Terminus Exists in the Roof of the 1900 Addition

Picture 8



A Round Duct of Undetermined Purpose - Open to the Attic

Picture 9



Hinged Window above Hallway Doors (Called A Transom)

Picture 10



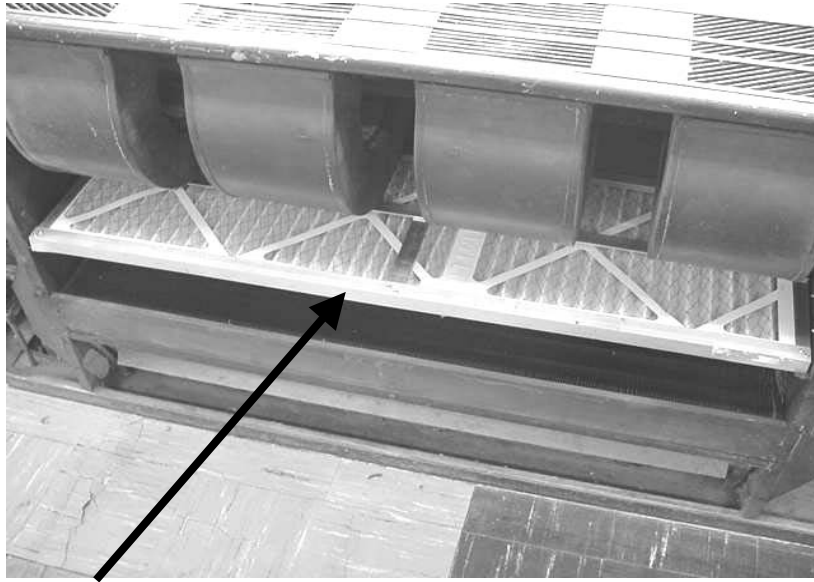
Damaged Brickwork on the Exterior Wall of the Cafeteria Classroom

Picture 11



Damaged Paint beneath Fire Escape

Picture 12



Retrofitted Filter System in Univent

Picture 13



Spaces Around Pipes – Observed Within All Univent Cabinet Interiors

TABLE 1

Indoor Air Test Results –Virginia Blanchard Elementary School, Uxbridge, MA-October 26, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	366	61	21					
Basement/kitchen	852	75	28	18	Y	N	N	Holes in walls and ceiling No airflow detected in exhaust vent
001 test AM	552	72	27	0	Y	Y	N	1 missing ceiling tile 1 water damaged ceiling tile Only univent with fresh air intake Door open No airflow detected in exhaust vent
001 retest PM	496	69	31	0	Y	Y	N	
202	735	73	27	18	Y	Y	Y	Paint chips in ceiling Transom closed Door open No airflow detected in exhaust vent
203	921	75	31	18	Y	Y	Y	Transom closed Door open No airflow detected in exhaust vent

* ppm = parts per million parts of air
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –Virginia Blanchard Elementary School, Uxbridge, MA-October 26, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
204	962	73	30	19	Y	Y	Y	Exhaust sealed with plywood Door open No airflow detected in exhaust vent
205	811	72	29	0	Y	N	Y	No airflow detected in exhaust vent
205 special education	655	72	27	0	Y	Y	Y	No airflow detected in exhaust vent
201	936	72	29	14	Y	Y	Y	Exhaust vent sealed Paint chips in ceiling Door open No airflow detected in exhaust vent
2 nd floor restroom								Water damaged ceiling plaster Paint chips No airflow detected in exhaust vent
101	875	72	29	13	Y	Y	Y	Door open No airflow detected in exhaust vent
105	786	73	29	1	N	N	Y	Door open No airflow detected in exhaust

* ppm = parts per million parts of air
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 3

Indoor Air Test Results –Virginia Blanchard Elementary School, Uxbridge, MA-October 26, 2001

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
								vent
104	749	74	30	1	Y	N	Y	Exhaust vent blocked with file cabinets Door open
103	629	73	30	2	Y	Y	Y	No airflow detected in exhaust vent

Comfort Guidelines

* ppm = parts per million parts of air
CT = ceiling tiles

Carbon Dioxide - < 600 ppm = preferred
 600 - 800 ppm = acceptable
 > 800 ppm = indicative of ventilation problems
 Temperature - 70 - 78 °F
 Relative Humidity - 40 - 60%

Table 4

Ceiling Test Results

LOCATION (ROOM)	TEST RESULT (mg/cm ²)	LOCATION (ROOM)	XRF RESULTS (mg/ cm ²)
103	9.9	Bathroom @ 203	0.2
Coat Room @ 102	0.3	Coat Room, 2 nd Floor	-0.1
Stairway @ 101	0.1	Hallway, 2 nd Floor	-0.2
201	0.5	202	0.5
204	1.9		

Table 5
Window Sash Readings

ROOM	LOCATION (SIDE)	COVINO (mg/ cm ²)	CLPPP (mg/ cm ²)	AAS (% BY Dry Weight)
103	B-3	1.8	1.7	0.81
103	B-5	2.0	1.6	0.39
103	B-6	2	1.5	N/A**
102	C-1	1.9	2.1	0.82
102	C-2	1.9	1.7	0.12
102	D-3	1.5	1.7	0.05
001	B-2	N/A*	1.5	3.30
001	B-4	N/A*	1.8	0.40
002	D-2	1.6	1.7	4.38
002	D-3	1.4	1.4	7.20

* The REPORT PAGE FOR Room 001 was not available

** Insufficient amount of paint for testing